New Hampshire Volunteer River Assessment Program

COCHECO RIVER
1999
Water Quality Monitoring Report

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Acknowledgements

Many individuals contribute enthusiasm and dedication to the exploration and stewardship of New Hampshire rivers. The New Hampshire Department of Environmental Services extends sincere thanks to the volunteers and supporters participating in the Volunteer River Assessment Program:

- The volunteers give their time and energy toward the monitoring of water quality indicators and characteristics.

- The continued dedication of DES Commissioner Robert W. Varney enables volunteer monitoring support services to be extended across New Hampshire through DES lake and river assessment programs and partnerships.

- The DES Volunteer Lake Assessment Program serves as an overall model for the relatively new Volunteer River Assessment Program (VRAP). The University of New Hampshire Lakes Lay Monitoring Program, Great Bay Coast Watch, River Watch Network and the Merrimack River Watershed Council Volunteer Environmental Monitoring Network provide a wealth of experience and guidance for VRAP.

- The local organizations including Conservation Commissions, Regional Planning Commissions, schools, and municipal waste and drinking water treatment facilities contributing resources to citizen monitoring are helping to create sustainable and community based monitoring programs.

- A growing number of individuals, organizations, agencies and DES staff support VRAP by participating in monitoring activities, offering suggestions and initiating partnerships.

- The New Hampshire Estuaries Project (NHEP) and the DES Non-point Source, Ambient Sampling, and Source Water Protection programs augment volunteer efforts with funding and organizational support for monitoring projects.

- Senator Judd Gregg, for securing generous funding for VRAP equipment, is recognized as a supporter of volunteer monitoring efforts in New Hampshire and an advocate for natural resource protection.

1999 Cocheco River Watch Volunteer Monitors

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Introduction

There are over ten thousand miles of rivers and streams in New Hampshire, stretching through our communities from the Canadian border all the way to the Atlantic Ocean. Healthy water resources are an indispensable part of our existence- we rely on clean water for drinking, recreational use, commercial and industrial supply. We also use surface waters for transportation purposes and as receiving waters for both industrial and municipal waste discharges. The development of land for residential, commercial and industrial purposes places additional pressure on surface waters. The New Hampshire Department of Environmental Services (DES) is charged with evaluating and regulating the quality of our surface waters, and is expanding its role in supporting and standardizing volunteer water quality monitoring to promote environmental monitoring and stewardship.

Since 1985 the DES Volunteer Lake Assessment Program (VLAP) has supported volunteer monitoring of New Hampshire lakes. VLAP volunteers collect water quality information about 130 lakes and ponds in New Hampshire each summer, contributing information about these waters that would otherwise be unattainable. The huge success and popularity of VLAP serves as a model for the Volunteer River Assessment Program (VRAP).

In New Hampshire there are watershed associations, local advisory committees and other established river interest groups sustained in a large part by volunteer efforts. Several of these groups have existing water quality monitoring programs and many have expressed interest in exploring and inventorying local water resources. VRAP ("vee-rap") was established in 1998 to provide support for these groups in the form of study design aid, technical assistance and training, loans of monitoring equipment, and data warehousing.

VRAP is an education and technical assistance program designed to support and coordinate volunteer monitoring of New Hampshire rivers. The main goals of VRAP are as follows:

- To educate the public about rivers and water quality;
- To organize groups to monitor water quality according to their goals;
- To provide monitoring guidelines, equipment loans, and technical training;
- To standardize data collection and management; and
- To report results and recommendations to volunteers.

General River Quality

The State Legislature classifies the New Hampshire surface waters according to what is known about their existing and historical quality and the uses they are required to support. The waters in each classification must satisfy all of the requirements of lower classifications. Currently there are two classes of surface waters in New Hampshire: Class A and Class B. According to the New Hampshire Revised Statutes Annotated (RSA 485-A:8):

> **"There shall be no discharge of any sewage or wastes into Class A waters, and these shall be considered as being potentially acceptable for water supply uses after adequate treatment."**
>
> **Class B waters "shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies".**

State water quality officials monitor and regulate surface waters for compliance with the State of New Hampshire Surface Water Quality Regulations, set forth in RSA 485-A:8 and administrative rules Env-Ws 430. The overall goal is that all surface waters attain and maintain specified standards of water quality to achieve the purposes of the legislative classification. The DES Ambient Sampling Program conducts annual water quality sampling of rivers and streams in the state. Ambient samples represent the conditions of the water at the time they were taken and are analyzed for selected chemical and bacteriological parameters. The results are summarized in two reports: the annual DES Ambient Water Quality Report and the biennial 305(b) Report to Congress.

The annual data are presented and analyzed in the Ambient Water Quality Report. The results are used to:

- Evaluate attainment of New Hampshire water quality standards;
- Update baseline data used to determine long term water quality trends;
- Determine the capacity of receiving waters to assimilate waste loading;
- Assess potential toxic impacts;
- Determine the progress of restoration projects and Best Management Practices; and
- Determine if additional sampling is needed or where water quality violations exist.

In the 305(b) Report to Congress, the waterbodies not meeting their legislated classification are listed with the parameter in violation along with the probable source of the violation. This information is used on the federal level to determine where preservation, restoration and further assessment dollars will be spent across the country. Available funding is distributed among the states primarily through the United States Environmental Protection Agency (EPA) and constitutes the major source of funding our state water pollution control agency uses to accomplish water quality evaluation, restoration and preservation activities.

The DES Volunteer River Assessment program was established to augment water quality data collection efforts. VRAP aims to provide a mechanism for accessing local knowledge, creating reverence for water resources and increasing the volume and availability of information about New Hampshire rivers.

Monitoring Parameters

VRAP loans water monitoring kits that include meters and supplies for measuring five basic, or baseline, water quality parameters: water temperature, dissolved oxygen, pH, conductivity, and turbidity. Volunteers are trained to make measurements with these instruments at locations in the river that help pinpoint water quality assets and concerns. Baseline measurements repeated over time create a picture of the natural fluctuations in water quality and help to determine where improvements, restoration or preservation may benefit the river.

The investigation of additional parameters such as nutrients and bacteria is conducted by state water quality personnel and can be pursued by volunteer monitors. Sampling additional parameters comes with the cost of analysis, which can be covered by an assortment of fundraising activities such as grants, association membership fees, special events, or in-kind services, which are non-monetary contributions from individuals and organizations.

Below is a description and the environmental significance of some parameters typically sampled. New Hampshire Surface Water Quality Regulations are included where applicable to the following:

Temperature

Temperature is one of the most important and commonly observed water quality parameters. Temperature influences the rate of many physical, chemical and biological processes in the aquatic environment. Each aquatic species has a range of temperature and other factors that best support its reproduction and the survival of offspring. Temperature also impacts aquatic life because of its influence on other parameters, such as the concentration of dissolved oxygen in the water.

Temperature in Class B waters shall be in accordance with RSA 485-A:8, II, which states in part "any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

Dissolved Oxygen

Adequate oxygen dissolved in the water is essential to the survival and successful reproduction of many aquatic species. Fish and other organisms use gills to transfer oxygen to their blood for vital processes that keep them active and healthy. Oxygen is dissolved into surface waters from the atmosphere, aided only by wind and wave action at the surface and by tumbling over rocks and uneven terrain. Aquatic plants and algae do produce oxygen in the water, but this contribution is offset by decomposition and respiration. Bacteria use oxygen as they process (decompose) plants and other organic materials in the river into smaller particles, and many aquatic organisms use oxygen in the process of respiration (breathing). Because of these natural processes oxygen levels are constantly changing and reflect a combination of factors.

Oxygen concentrations in water are measured using a meter that produces readings for both milligrams per liter and percent saturation of dissolved oxygen (DO). For Class B waters, any single DO reading must be greater than 5 mg/L for waters meeting New Hampshire water quality standards. This means that in every liter of water there are at least five milligrams of dissolved oxygen available for ecosystem processes.

More than one measurement of oxygen saturation taken in a twenty-four hour period can be averaged to compare with water quality standards. Class B waters must have a dissolved oxygen content of not less than seventy five percent of saturation, based on a daily average, to satisfy aquatic habitat requirements. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Percent of saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the percent saturation has recovered to acceptable levels. Water can become saturated with more than one hundred percent dissolved oxygen, often observed below dams where the falling waters gather oxygen from the atmosphere.

There are other requirements in the New Hampshire administrative rules, Env-Ws 430, relative to cold water fish spawning areas, impoundments (dams), and reservoirs.

pH

pH is an indicator of hydrogen ion activity in water, measured on a logarithmic scale of zero to fourteen. The lower the pH, the more acidic the solution due to higher concentrations of hydrogen ions. A high pH is indicative of an alkaline or basic environment. Acid rain typically has a pH of 3.5 to 5.5. New Hampshire rivers have historically shown a range of pH values from 4.5 to 9. Most aquatic species require a

relatively stable pH between 5 and 9. The toxicity of aquatic compounds such as ammonia and certain metals is also affected by pH.

New Hampshire Surface Water Quality Regulations state that pH shall be between 6.5 and 8, unless naturally occurring. Often readings outside this range are determined to be naturally occurring because of the influence of wetlands near the sample site. In areas influenced by wetlands, tannic and humic acids released into the water by decaying plants can create acidic waters.

Conductivity

Conductivity is the numerical expression of the ability of water to carry an electric current. Formally termed specific conductance, conductivity is a measure of the free ion content in water. Water contains ions, or charged particles, such as magnesium (Mg^{2+}) and calcium (Ca^{2+}). These materials carry an electrical current and come from natural sources, such as soils and bedrock, or are introduced by human activity.

There is no standard for conductivity, because levels vary a great deal according to the geology of an area. Conductivity readings are useful in locating potential pollution sources because impacted surface waters usually have higher specific conductance than unimpaired waters. Conductivity tests can be used to indicate the potential presence of chlorides, nitrates, sulfates, phosphates, sodium, magnesium, calcium, iron, or aluminum ions, prior to any financial investment into analyzing specifically for these substances.

Turbidity

Turbidity is an indicator of the amount of suspended material in the water, such as clay, silt, algae, suspended sediment, and decaying plant material. A high degree of turbidity can interrupt the passage of light through the water and add heat to the water by absorbing sunlight. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events often contribute turbidity to surface waters by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters.

Class B waters shall not exceed naturally occurring conditions by more than ten turbidity units (NTUs). In order to determine compliance with the water quality standards, information about background turbidity levels is needed. Volunteer data can be used to supplement data already collected by DES to help determine if turbidity is a problem in a particular watershed.

Bacteria

Organisms causing infections or disease (pathogens) are excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is not considered pathogenic. *E. coli* is, however, almost universally found in the intestinal tracts of humans and other warm-blooded animals and is relatively simple and

inexpensive to measure. For these reasons *E. coli* is used as an indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. Class B waters shall contain no greater than 406 *E. coli* counts per one hundred milliliters CTS/100mL in any one sample, or not more than either a geometric mean based on at least three samples obtained over a sixty-day period of 126 *E. coli* (CTS/100mL).

Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, but in excessive amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact on biological activity in the water. Excess phosphorus can trigger algal blooms and aquatic plant growth. As a result, large amounts of decomposing organic material can decrease oxygen levels and the attractiveness of waters for recreational purposes.

Phosphorus can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. There is no surface water quality standard for phosphorus due to the high degree of natural variability and the difficulty of pinpointing the exact source. However 0.05 mg/L total phosphorus is used as a level of concern, which means DES pays particular attention to readings above this level.

Metals

Depending on the metal concentration, its form (dissolved or particulate) and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal and render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. Higher hardness concentrations buffer the toxicity of certain metals. The metals standards are not detailed here due to their complexity.

Project Description

The Cocheco River Watershed Coalition (Coalition) first investigated water quality in 1998 with DES Non-point Source staff. The Coalition was interested in exploring water quality in the river system further. Strafford Regional Planning Commission submitted a Local Initiative Program grant application to DES and was awarded funding to support a coordinator for the project and coverage for sampling in addition to the VRAP baseline parameters. The City of Rochester Public Works Department donated in-kind services including analysis for *E. coli* bacteria and an extremely valuable municipal partnership. The Volunteer River Assessment Program provided field training and equipment.

Three monitoring teams complete with field leaders became known as the very dedicated 1999 Cocheco River Watch. Every other week from May 24th through September 20th, 1999, volunteers reached the river in the early morning hours to analyze the water for the VRAP baseline parameters and to collect bacteria samples for analysis at the Rochester Waste Water Treatment Facility before 10 a.m. Twice during the summer samples were collected for metals analysis conducted at the DES Laboratory Services Unit in Concord. DES Laboratory Services and the UNH Lakes Lay Monitoring Program analyzed biweekly samples for total phosphorus.

Ten sites on the mainstem of the Cocheco River were monitored every other week from its upper limits in Farmington to the tidal dam in Dover. Sampling sites for the 1999 CRW project were selected from among those previously tested by the DES Ambient Sampling Program. Potential problem areas throughout the watershed were identified by the Coalition with guidance from DES staff through a group review of historical data, recent water quality sampling results, and observations of river conditions. Refer to Appendix A for site locations and maps.

Data generated by this project will be used in educational outreach for thirteen watershed communities; by interest groups and the general public; for long-term watershed management; and for decision-making by community land use boards and departments of planning and public works. Regionally, the data will be provided to coastal watershed agencies and organizations for use in resource planning.

Results and Discussion

VRAP baseline parameters, nutrients, metals and bacteria results are reported by site, from upstream to downstream. Under each parameter heading (i.e. “Bacteria”) there is a code for the site indicating the number of samples collected that year and the number of samples that did not meet the water quality standard, where applicable. For example, if there were twelve samples collected and nine of them did not meet standards, the code would read as follows: “12-9”. Where there is no standard but a level of concern had been designated by NHDES, a narrative description of these conditions will be given.

26-Cch. Central Street Bridge, Farmington, NH:

Dissolved Oxygen
9-1 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation was monitored at 26-Cch every two weeks in the summer of 1999. Out of nine samples measured eight were above the required minimum instantaneous concentration of 5 mg/L, ranging from 3.75 to 10.57 mg/L. The measurement made on September 7, 1999, was 3.75 mg/L. The monitoring team reported that this sample was taken at extremely low river flow conditions and the river resembled a puddle at the time. This location on the river met the DO standard, with natural, low-flow conditions responsible for the depressed DO concentration measured in September 1999.

All of the samples had at least 75% saturation, except for the reading on September 7, 1999, ranging from 42.3 to 99.8% saturation. These readings suggest that for most of the summer this river segment is meeting the criteria that support a healthy aquatic ecosystem. The instance in which the percent of saturation was not adequate was recorded when the river had naturally occurring low-flow conditions.

pH
9-6 (unless naturally occurring)

The pH values recorded in 1999 at 26-Cch ranged from 5.54 to 6.89. Six of these measurements were below the lower end of the standard range for pH (6.5 to 8). Natural causes, such as drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in the river here. Additional investigations into the drainage area are necessary to determine the cause of the low pH measurements.

Bacteria
9-3

Three of nine samples collected contained greater than 406 *E. coli* CTS/100mL, exceeding the state recreational standard. Bacteria results ranged from 20 to 1980 CTS/100mL. Six duplicate samples were analyzed and indicated the general level of bacteria was consistent between samples and duplicates. The bacteria concentrations exceeding the standard occurred on days when it was raining during sampling or when showers had occurred previous to the sample collection. This may indicate that runoff containing *E. coli* bacteria is washing into the river from the shores and or nearby wetland areas.

Nutrients

Total phosphorus samples were collected eight times at 26-Cch, ranging from 0.009 to 0.027 mg/L. All of these concentrations were below 0.05 mg/L, the DES level of concern for total phosphorus.

Note that samples collected from May 24 through July 12, 1999, were submitted to the laboratory after the holding time had expired. This means that the data for these samples do not meet the quality assurance and control requirements. However, some scientific literature indicates that total phosphorus samples that are acidified and frozen are stable for at least six months (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C).

Four duplicate samples were analyzed, indicating that the general level of total phosphorus found in the samples and duplicates was consistent.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for each metal or below the limit for Class B water quality.

23-Cch. Watson Corner Road Bridge, Farmington, NH:

Dissolved Oxygen
9-0 (< 5 mg/L minimum)

A total of nine samples were measured, all above the required minimum instantaneous limit of 5 mg/L. However, four of the samples measured less than 75% saturation, ranging from 65% saturation in mid-July to 96% saturation toward the end of September. These readings suggest that for at least part of the day the river may not be meeting the criteria that support a healthy aquatic ecosystem. Additional information about the daily average percent saturation of dissolved oxygen is needed to determine whether or not the river is meeting the state standard at this location.

pH
9-5 (unless naturally occurring)

The pH values recorded in 1999 at 23-Cch ranged from 5.70 to 6.59. Five of nine measurements were below the lower end of the standard range for pH (6.5 to 8). Natural causes, such as drainage from wetland areas and non-point sources in the nearby

watershed may be affecting the pH levels in this river segment. Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-2

Nine samples were collected for bacteria analysis at 23-Cch, ranging from 30 to 680 *E. coli* CTS/100mL. Two of these samples were greater than 406 CTS/100mL, exceeding the state recreational standard. The bacteria concentrations exceeding the standard occurred on days when it was raining during sampling or when showers had occurred previous to sampling. This may indicate that materials containing *E. coli* bacteria are being washed into the river from the shores and or nearby wetland areas.

Two duplicate samples were analyzed, confirming the general level of bacteria in the samples and duplicates to be consistent.

Nutrients

Total phosphorus samples were collected nine times at 23-Cch, ranging from 0.021 to 0.151 mg/L. Four of these samples met the quality assurance and control requirements for the project (samples collected between May 24 and July 12, 1999, were submitted to the laboratory after their holding time had expired; see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The four samples meeting the quality assurance and control requirements ranged from 0.021 to 0.015 mg/L, none with total phosphorus concentrations greater than the NHDES level of concern.

Some historical Ambient water quality data collected indicate that total phosphorus levels at this location have been above the DES level of concern of 0.05 mg/L, ranging from 0.026 to 0.112 mg/L. Potential sources of the high phosphorus concentrations include Farmington Waste Water Treatment Facility and wetlands, golf courses, and gravel pits in the area.

One duplicate sample was analyzed, confirming the general level of total phosphorus found in the samples to be consistent.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999, and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

22C-Cch. Pike Industries Bridge, Farmington, NH:

Dissolved Oxygen
9-6 (< 5 mg/L minimum)

The DO concentrations at this location ranged from 3.18 to 8.7 mg/L. Six out of nine times the river was sampled the minimum instantaneous concentration of 5 mg/L DO was not met. These data suggest that this location in the river is not supporting the designated aquatic life criteria.

Seven of the nine samples did not have 75% of saturation, ranging from 34.3 to 88% of saturation. These readings suggest that for at least part of the day the river is not meeting the criteria that support a healthy aquatic ecosystem. Additional information about the daily average percent of saturation is needed to determine whether or not the river is meeting the dissolved oxygen percent of saturation standard at this location.

Drainage from wetland areas in the nearby watershed may be affecting the DO levels in this river segment. There is also the possibility that non-point sources are complicating the situation, and that the landfills upstream from this location may be contributing poorly oxygenated groundwater to the river. Additional investigations into the drainage area are necessary to determine the cause of the depressed DO levels.

pH
7-5 (unless naturally occurring)

The pH values recorded in 1999 at 22C-Cch ranged from 5.61 to 6.55. Five of the seven measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in this river segment. Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-0

None of the samples collected for bacteria analysis at 22C-Cch contained greater than 406 *E. coli* CTS/100mL. The bacteria levels ranged from 10 to 290 *E. coli* CTS/100mL, all meeting the state recreational standard.

Nutrients

Total phosphorus samples were collected eight times at 22C-Cch, ranging from 0.007 to 0.083 mg/L. Four of these samples met the quality assurance and control requirements for the project (samples collected between May 24 and July 12, 1999, were submitted to the laboratory after their holding time had expired; see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The four samples meeting the quality

assurance and control requirements were all below 0.05 mg/L, the NHDES level of concern for total phosphorus, and ranged from 0.007 to 0.032 mg/L.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

22-Cch. Little Falls Road Bridge, Rochester, NH:

Dissolved Oxygen
8-0 (< 5 mg/L minimum)

The DO concentrations at this location ranged from 5.26 to 9.36 mg/L, all above the minimum instantaneous concentration of 5 mg/L. One of the dissolved oxygen measurements recorded at this site on June 28, 1999, was discarded. The meter indicated that the water contained 35 mg/L and 400% saturation of DO, well outside the observed range of DO values in NH rivers. It was later determined that power lines at the site may have caused these erroneous readings by interfering with the proper functioning of the analytical meter.

Three of the eight samples did not have at least 75% of saturation, ranging from 59.3 to 91.5% of saturation. These readings suggest that for at least part of the day the river may not be meeting the criteria that support a healthy aquatic ecosystem. Additional information about the daily average percent of saturation is needed to determine whether or not the river is meeting the dissolved oxygen percent of saturation standard at this location.

pH
8-8 (unless naturally occurring)

The pH values recorded in 1999 at 22-Cch ranged from 5.81 to 6.38. All of the measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in this river segment. Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
8-0

Eight samples were collected for bacteria analysis at 22-Cch, none measuring more than 406 *E. coli* CTS/100mL. The bacteria levels ranged from 40 to 290 *E. coli* CTS/100mL, all meeting the state recreational standards.

Nutrients

Total phosphorus samples were collected eight times at 22-Cch, ranging from 0.014 to 0.072 mg/L. Four of these samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). Of these four samples all concentrations of total phosphorus were below 0.05 mg/L, the NHDES level of concern, and ranged from 0.014 to 0.018 mg/L.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

21-Cch. North Main Street Bridge, Rochester, NH:

Dissolved Oxygen
8-1 (< 5 mg/L minimum)

The DO concentrations at this location ranged from 4.83 to 7.73 mg/L. One of the measurements was below the minimum instantaneous concentration of 5 mg/L, indicating that this river segment is not meeting the state aquatic life support standard throughout the summer.

Five of the eight samples did not have at least 75% saturation, ranging from 52.8 to 89.9% saturation. These readings suggest that for at least part of the day the river may not be meeting the criteria that support a healthy aquatic ecosystem. Additional investigations in to the drainage area are necessary to determine the cause of the depressed DO levels. Measuring the daily average percent of saturation is required to determine whether or not the river is meeting the dissolved oxygen percent of saturation standard at this location and because the area is impounded behind a dam, and clogged with aquatic plants, special investigations will determine if at least the top 25% of the impounded area is saturated with at least 75% dissolved oxygen.

pH
8-5 (unless naturally occurring)

The pH values recorded in 1999 at 21-Cch ranged from 5.72 to 6.63. Five of the measurements taken were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in this river segment. Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
8-0

Eight samples were collected for bacteria analysis at 21-Cch, none measuring more than 406 *E. coli* CTS/100mL. The bacteria levels ranged from 30 to 240 *E. coli* CTS/100mL, all meeting the state recreational standards.

Nutrients

Total phosphorus samples were collected seven times at 21-Cch, ranging from 0.01 to 0.032 mg/L. Three of these samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). Of these three samples all concentrations of total phosphorus were below 0.05 mg/L, and ranged from 0.01 to 0.02 mg/L.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

19-Cch. Route 125 Bridge, Rochester, NH:

Dissolved Oxygen
9-0 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation was monitored at 19-Cch every two weeks in the summer of 1999. Out of nine samples all measured above the required minimum instantaneous concentration of 5 mg/L, ranging from 5.29 to 9.31 mg/L. This location on the river meets the state recreational DO standard.

Five of the nine measurements were below 75% saturation, ranging from 57.0 to 90.2% saturation. These readings suggest that for most of the summer this river segment may not be meeting the criteria that support a healthy aquatic ecosystem.

pH
9-4 (unless naturally occurring)

The pH values recorded in 1999 at 19-Cch ranged from 6.19 to 6.75. Four of these measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be

affecting the pH levels in the river here, and additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-4

Four of nine samples contained greater than 406 *E. coli* CTS/100mL, exceeding the state recreational standard. Bacteria results ranged from 200 to 1570 CTS/100mL. The bacteria concentrations exceeding the standard occurred on days when it was raining during sampling or when showers had occurred previous to the sample collection. This may indicate that materials containing *E. coli* bacteria are being washed into the river from the shores and or nearby wetland areas.

Nutrients

Total phosphorus samples were collected eight times at 19-Cch, ranging from 0.028 to 0.041 mg/L. All of these concentrations were below 0.05 mg/L, the DES level of concern for total phosphorus. Four of the samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). Of these four samples all concentrations of total phosphorus were below 0.05 mg/L, and ranged from 0.03 to 0.041 mg/L.

Metals
6-0

Samples for total metals analysis were collected on two dates in 1999, and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. On September 5, 1999, the concentration of zinc in the sample collected at this location was 0.0778 mg/L, which is greater than the acute limit for Class B water quality (0.0354 mg/L). Further sampling is necessary to confirm and investigate this result.

12-Cch. Strafford County Farm, Dover, NH:

Dissolved Oxygen
9-2 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation were monitored at 12-Cch every two weeks in the summer of 1999. Two of nine samples measured were below the required minimum instantaneous concentration of 5 mg/L, ranging from 4.50 to 10.4 mg/L. This river segment did not meet the state DO standard.

Five of the nine measurements were below 75% saturation, ranging from 57.0 to 90.2% saturation. These readings suggest that for most of the summer this river segment may not be meeting the criteria that support a healthy aquatic ecosystem.

The placement of the sampling location may have had an influence on the results at this site. The site is at the upstream end of a long impounded, or ponded, stretch and the river

curves around a bend just prior to the sampling location. The flow coming around the bend travels through a vegetated shoreline area and potentially pulls water with depressed oxygen levels from this vegetated area and the ponded area upstream out into the middle of the river where the measurements were performed. This site was also difficult for volunteers to access. There is a great deal of poison ivy surrounding the location and getting a sample from the free-flowing portion of the river was a challenge.

pH
9-4 (unless naturally occurring)

The pH values recorded in 1999 at 12-Cch ranged from 6.13 to 7.1. Four of these measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in the river here.

Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-0

Each of the nine samples collected at 12-Cch in 1999 met the state recreational standard, containing less than 406 *E. coli* CTS/100mL. Bacteria results ranged from 20 to 300 CTS/100mL.

Nutrients

Total phosphorus samples were collected eight times at 12-Cch, ranging from 0.095 to 1.81 mg/L. All concentrations of total phosphorus were above 0.05 mg/L. Four samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The samples meeting quality assurance and control requirements ranged from 0.296 to 1.81 mg/L.

This site is located downstream of the Rochester Waste Water Treatment Facility. The treatment facility contributes to total phosphorus loading into the river at this location. This may depress DO levels in the river by stimulating excessive plant growth, which consumes DO as it decays. There are also other factors upstream in the watershed that may be impacting the system at this location. The upcoming upgrade of operations at the Rochester Wastewater Treatment Facility is expected to improve river conditions over time at this site, and will allow us to see other factors contributing to water quality conditions more clearly in future monitoring results.

Metals
6-0

Samples for total metals analysis were collected on two dates in 1999, and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc.

All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

11-Cch. Watson Road, Dover, NH:

Dissolved Oxygen
9-0 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation was monitored at 11-Cch every two weeks in the summer of 1999. All of nine samples measured were above the required minimum instantaneous concentration of 5 mg/L, ranging from 6.09 to 11.0 mg/L.

One of the nine measurements was below 75% saturation, ranging from 67.6 to 97.6% saturation. These readings suggest that for most of the summer this river segment met the criteria that support a healthy aquatic ecosystem.

pH
9-5 (unless naturally occurring)

The pH values recorded in 1999 at 11-Cch ranged from 5.9 to 6.8. Five of these measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in the river here. Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-1

One of the nine samples collected at 11-Cch in 1999 was above the state recreational standard of less than 406 *E. coli* CTS/100mL. Wet weather conditions may have caused bacteria to be washed into the river from adjacent areas. Bacteria results ranged from 0 to 850 CTS/100mL.

Nutrients

Total phosphorus samples were collected eight times at 11-Cch, ranging from 0.054 to 6.38 mg/L. All concentrations of total phosphorus were above 0.05 mg/L. Four samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The samples meeting quality assurance and control requirements ranged from 0.054 to 6.38 mg/L.

The Tolend Landfill upstream from this location may be contributing to the phosphorus load in this river segment. The extremely high total phosphorus concentrations may also be due to the entrapment of aquatic vegetation in nutrient samples. Duckweed grows profusely at this site, making it difficult not to include plant material in samples.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

10-Cch. Whittier Street Bridge, Dover, NH:

Dissolved Oxygen
9-0 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation were monitored at 10-Cch every two weeks in the summer of 1999. All samples measured above the required minimum instantaneous concentration of 5 mg/L, ranging from 6.14 to 9.65 mg/L.

Two of the nine measurements were below 75% saturation, ranging from 71.8 to 95% saturation. These readings suggest that for at least part of the day the river may not be meeting the criteria that support a healthy aquatic ecosystem. Additional information about the daily average percent of saturation is needed to determine whether or not the river is meeting the dissolved oxygen standard at this location.

pH
9-4 (unless naturally occurring)

The pH values recorded in 1999 at 10-Cch ranged from 6.25 to 7.2. Four of these measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in the river here.

Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-0

None of the nine samples collected at 10-Cch in 1999 exceeded the state recreational standard of less than 406 *E. coli* CTS/100mL. Bacteria results ranged from 20 to 370 CTS/100mL.

Nutrients

Total phosphorus samples were collected eight times at 10-Cch, ranging from 0.06 to 0.208 mg/L. Four samples met the quality assurance and control requirements for the

project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The samples meeting quality assurance and control requirements ranged from 0.06 to 0.208 mg/L

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

07-Cch. Central Avenue Bridge, Dover, NH:

Dissolved Oxygen
9-0 (< 5 mg/L minimum)

Dissolved oxygen (DO) concentration and percent saturation were monitored at 07-Cch every two weeks in the summer of 1999. All samples measured above the required minimum instantaneous concentration of 5 mg/L, ranging from 7.49 to 9.71 mg/L.

None of the nine measurements were below 75% saturation, ranging from 83.7 to 114.7% saturation. These readings suggest that this river segment is meeting the DO criteria that support a healthy aquatic ecosystem.

pH
9-3 (unless naturally occurring)

The pH values recorded in 1999 at 07-Cch ranged from 6.18 to 7.4. Three of these measurements were below the lower end of the standard range for pH (6.5 to 8). Drainage from wetland areas and non-point sources in the nearby watershed may be affecting the pH levels in the river here.

Additional investigations into the drainage area are necessary to determine the cause of the low pH levels.

Bacteria
9-1

One of the nine samples collected at 10-Cch in 1999 exceeded the state recreational standard of less than 406 *E. coli* CTS/100mL. Wet weather conditions may be causing high bacteria concentrations at this location. Bacteria results ranged from 10 to 1030 CTS/100mL.

Nutrients

Total phosphorus samples were collected eight times at 07-Cch, ranging from 0.054 to 0.145 mg/L. Four samples met the quality assurance and control requirements for the project (see UNH Lakes Lay Monitoring Program data and documentation in Appendix C). The samples meeting quality assurance and control requirements ranged from 0.054 to 0.145 mg/L.

Metals
12-0

Samples for total metals analysis were collected on two dates in 1999 and analyzed for the concentration of six metals: aluminum, cadmium, chromium, copper, lead, and zinc. All of the results were below the minimum detection limit for the parameter or below the limit for Class B water quality.

Recommendations

After reviewing the data from Cocheco River, VRAP recommends the following actions:

- Further investigation through shoreline surveys will help interpret the data by providing information about potential impacts to surface water quality. The location of runoff, wetland areas, areas lacking vegetated buffers, and the characteristics of the land adjacent to the river will help confirm and determine the cause of exceedences of water quality standards. This information may then be used to correct problems that are not naturally occurring.

  Shoreline surveys should be conducted in Farmington near stations 26-Cch, 23-Cch, 22C-Cch, 22-Cch and in Dover near 12-Cch, to determine the causes of low pH and DO measurements in 1999. Total phosphorus inputs to the river may be reduced by creating or increasing vegetated buffers along the riverbank and diverting into these buffer areas. The shoreline surveys will help determine where these remedies might be applied.

- VRAP suggests the use of Hydrolab® meters at locations in the watershed that exhibited low DO levels. A Hydrolab® is a meter that is deployed for a period of days, weeks, or months in the river to measure Water temperature, dissolved oxygen, pH, turbidity and conductivity simultaneously and at set time intervals. This information will help determine if the daily average values of dissolved oxygen are supporting aquatic habitat and if the river segment is meeting surface water quality regulations. The multi-parameter meters can also be placed above and below a suspected pollution source to determine the impact.

  VRAP can loan these multi-parameter meters, and suggests placing them at 23C-Cch, 23-Cch, 22C-Cch, 22-Cch, 21-Cch and 19-Cch in the summer of 2000. A Hydrolab® may also be placed in tributaries to the Cocheco River with sufficient

flow, such as Polkamoonshine Brook in Farmington, to collect additional information about the quality of the water coming into the system.

- Additional investigations into sources of bacteria in the watershed are recommended at 26-Cch, 23-Cch, and 19-Cch, where bacteria violations were documented in 1999. Relationships with the municipalities in the watershed should be continued and cultivated to accomplish bacteria sampling at a local laboratory. Volunteers seeking additional experience with analyzing water samples may consider offering to work in a municipal lab filtering and incubating samples. VRAP is capable of providing equipment that may be necessary to accommodate the extra sample load in the laboratory.

- Reducing phosphorus inputs to the river can be accomplished by public education and outreach in the watershed. Waste Water Treatment Facilities (WWTFs) discharge phosphorus to the river. If the communities connected to a municipal waste disposal system reduce the amount of phosphorus they discharge to the WWTF, there would be less discharged to the river. The DES Pollution Prevention Program can provide educational guidance for groups wishing to do outreach related to waste reduction.

- Volunteers can investigate water quality conditions behind dams on the river and determine if the water meets standards by measuring dissolved oxygen at several locations and depths. The top 25% of the water depth behind a dam in New Hampshire is required to have a daily average of at least 75% saturation. Measurements recorded by the Coalition in 1999 suggest that the river may not be meeting the required DO criteria at 21-Cch. Investigations of the other impoundments in the watershed would also help DES determine whether standards are being met.

- VRAP encourages the continuation of the effort to monitor baseline conditions in the Cocheco River. The Cocheco River and coastal watersheds in New Hampshire are priority areas in the state for watershed evaluation, preservation and restoration activities. The sampling that has taken place has helped create the recommendations in this report. Additional sampling will augment the data collection and river management efforts of DES, as well as local decision makers.

- DES expects annual allocations of federal funds through the Clean Water Action Plans program created under President Clinton's administration. These funds can be used to implement restoration projects that address degraded waters found throughout the coastal watersheds. All volunteer groups in the 43 seacoast communities are encouraged to develop restoration projects. The New Hampshire Estuaries Project Management Plan is an excellent source of project ideas and DES is available to assist watershed groups in developing projects. Contact Natalie Landry, Coastal Watershed Supervisor at 271-5329 for assistance.